Cerro Blanco (Central Andes): The Largest Volcanic Eruption Of The Last 5000 Years

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One of the biggest mysteries concerning the origin of many recent volcanic ash deposits in NW Argentina has been solved. New data and interpretation about a major eruption — spreading more than 100 km^3 of ashes over about 500.000 km^2 — occurred around 4200 years ago in the Cerro Blanco Volcanic Complex. This eruption was the biggest of the last five millennia in the Central Volcanic Zone of the Andes and was possibly one of the largest Holocene eruptions in the world.

This discovery offers researchers an excellent, extensive regional chronostratigraphic marker for reconstructing mid-Holocene geological history over a wide geographical area of South America. The recognition of this significant volcanic event may shed new light on interpretations of critical changes observed in the mid-Holocene environmental, paleontological and archaeological records.

An improved understanding of the widespread ash-fall deposits occurring within the Upper Quaternary deposits in NW Argentina is key because they can serve as potential stratigraphic markers and provide a temporal framework for estimation of sedimentation rates, topographic reconstructions, assessment of landslide hazards, and archaeology. Moreover, they allow for modeling of the environmental geochemical impact of volcanism. It was thought that these deposits were related to multiple eruptions from the Central Volcanic Zone of the Andes due mainly to the limited and sometimes controversial available ages of proximal volcanic

products in the potential source areas of the Puna. This situation led us to conduct new research on these deposits.

The Cerro Blanco Volcanic Complex, encompassing an elevation ranging between 3500-4600 m, is part of the Cordillera de San Buenaventura volcanic field in NW Argentina (26°45′S, 67°45′W, Fig. 1). It is situated on the southern border of the Altiplano-Puna Plateau, where active volcanism occurs within the plateau and along its margins. 4200 years ago, the activity of this volcanic complex produced lava-domes, proximal pyroclastic flow deposits, and proximal and distal fall deposits of rhyolitic composition.

Location map of Cerro Blanco volcano. Figure courtesy José Luis Fernández Turiel

During the climax of the eruption, a Plinian column of ash and gases reached more than 30 km high. Once in the stratosphere, more than 100 km^3 of ash were dispersed by strong winds to the east, affecting an area of more than 500,000 km^2. The thickness of the resulting deposits exceeded several tens of meters near the vent to more than 30 cm near Santiago del Estero (at 400 km from the source). This thickness decrease is not linear because it is greatly affected by the relief. Thus, 3-4 m thick deposits were produced at places more than 200 km from the volcano.

Another impressive impact of this eruption was the pyroclastic flow deposits that filled as far as 35 km of valleys located around of Cerro Blanco.

The implications of these findings of the Cerro Blanco eruption reach far beyond providing an excellent chronostratigraphic marker for reconstructing mid-Holocene geologic history for an extensive area of South America. On the other hand, it is unlikely that an extensive tephra deposit would remain on the Earth's surface for very long without reworking and redeposition. The interaction of ash with wind and water in the large affected hydrological basins mobilized huge amounts of both particulate material and chemical elements to the Chaco-Pampean Plain (Fig. 1). The impact of this eruption on the environmental, palynological, faunal and archaeological records are open questions that may help to prevent hazards associated with these large eruptions.

These findings are described in the article entitled The large eruption 4.2 ka cal BP in Cerro Blanco, Central Volcanic Zone, Andes: Insights to the Holocene eruptive deposits in the southern Puna and adjacent regions, recently published in the journal *Estudios Geológicos*.

ABOUT THE AUTHOR(S)

José Luis Fernández Turiel

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My research interests focus on the natural and anthropogenic trace element fluxes and their fate in the geological record and environment. With observations in the field, laboratory experiments and modeling I contribute to developing new tools to constraint spatial and temporal changes of past geosystems in response to large-scale geological processes (e.g., volcanic eruptions) in key regions of the world in order to provide decision criteria for stakeholders working to mitigate impacts and hazards on society.

Current work is focused on the impact of ash deposition in the Andes and the Chacopampean Plain in the South Cone of America (collaboration with IRNASA-CSIC and the University of Las Palmas de Gran Canaria in Spain, and the Universities of San Luis, Tucumán, Mar del Plata and Buenos Aires in Argentina). I am studying the mineral-water interaction to understand mainly the behavior of trace elements in drinking water treatment plants to improve the involved processes, including desalination plants. Key aspects are the development and application of geochemical source tracing techniques and modeling methods for water quality management in Mediterranean basins of South Europe (rivers Llobregat, Ter, Drama,...) and South America (Sali River). I develop and apply new methods for mineral exploration and environmental geochemistry based mainly on the analysis of rocks, soils, water, vegetation, etc. by ICP-MS. Recent work has developed a simple method that allows determining accurate and precise concentrations of sulfur and halogens in a multielement analysis in water by HR-ICP-MS (collaboration with the University of San Luis, Argentina). GIS-based geomorphological reconstructions also provide essential data to model the behavior of past and future environmental changes (collaboration with the University of Las Palmas de Gran Canaria, Spain).

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